

Early Quaternary channel incisions at the base of the Merksplas Formation at the southern margin of the North Sea Basin

Supplementary data

JEF DECKERS 

VITO – Flemish Institute of Technological Research, Boeretang 200, B-2400 Mol, Belgium;
corresponding author: jef.deckers@vito.be.

JAN WALSTRA 

Royal Belgian Institute of Natural Sciences, Geological Survey of Belgium, Jennerstraat 13, B-1000 Brussels, Belgium.

ARMIN MENKOVIC 

TNO – Geological Survey of the Netherlands, Princetonlaan 6, 3584 CB Utrecht, The Netherlands.

STIJN EVERAERT 

OD Earth & History of Life, Royal Belgian Institute of Natural Sciences, Vautierstraat 29, B-1000 Brussels, Belgium.

RIK HOUTHUYS 

Halle, Belgium.

ABSTRACT

Borehole log correlations provide the first evidence for >15 m deep channel incision in the base of the Quaternary at the southern margin of the North Sea Basin. The coarse sand of the lower Quaternary Merksplas Formation fills up the channels that were cut into the top of the subjacent fine, glauconite-bearing shelly sand of the upper Pliocene Lillo Formation. Channel erosion was locally able to remove the entire upper sandy unit (Merksem Member) of the Lillo Formation. The interpretation of a seismic line in the area shows that the channel erosion reached even deeper at some locations. The very coarse, poorly sorted infill of the channels, with plenty of reworked material, testifies to deposition under tidal or tidally enhanced currents. The channel incisions probably cut into the Lillo Formation during the earliest Quaternary sea-level lowstands. During a subsequent sea-level rise, tides entered the paleo-valleys and widened them. Channel lag deposits were formed with abraded shells and other intraclasts. The latter are overlain by a thicker fining-upward sequence, which is indicative of channel fills and mainly composed of coastal environment-sourced quartz sand.

KEYWORDS

borehole log correlations,
stratigraphy,
erosion,
Pleistocene,
tidal currents

Article history

Received 28.11.2023, accepted in revised form 01.10.2024, available online 15.05.2025.

Table 1. Overview of the boreholes used in this study and their informal names.

Belgium		The Netherlands	Informal name by this study	Code by this study (Figs 2, 4 & 5)
DOV	BGD	DINOLOKET		
kb7d6w-B85	006W0028		Essen-Hoek	3
kb7d6e-B297	006E0134		Essen-Wildert	C-4
kb7d6e-B296	006E0133		Kalmthout -Nieuwmoer	5
kb7d6e-B155	006E0130		Kalmthout - Putsesteenweg	A
kb7d6e-B298	006E0135		Kalmthoutse Heide	B
B/1-0358	001e0044		Essen - Centrum	D
		B49G0164	Woensdrecht	1
		B49G0204	Huijbergen	2
		B50C0077	Zundert - Achtmaal	6
		B50C0079	Zundert -Wernhout	7
		B49F0326	Nispen	E
		B49F0435	Roosendaal	F

Table 2. Overview of the boreholes used in this study, with the name of the authors of the original/reference interpretations and whether their interpretation is followed by this study or not (within a margin of 2 m). Given that the top of the Merksplas Formation was not yet interpreted in the original interpretations of the Dutch boreholes, we use the borehole set of Vernes et al. (2023) for comparison as ‘source interpretation’. The changes in the base of the Merksplas Formation in some of the Dutch boreholes compared to the reference interpretation of Vernes et al. (2023) are due to new insights in the correlations between the Merksplas Formation and the Dutch Waalre and Maassluis formations provided by Everaert et al. (2023).

Informal borehole name in this study	Source interpretation	Revised for this study? If yes, at what depth compared to the reference interpretation		
		Base Lillo Fm	Base Merksplas Fm	Top Merksplas Fm
Essen-Hoek	Laga & Notebaert, 1981a	76 m instead of 72 m	No	No
Essen-Wildert	Laga & Notebaert, 1981b	No	No	No
Kalmthout - Nieuwmoer	Laga & Notebaert, 1981c	Not reached	No	No
Kalmthout - Putsesteenweg	Deckers et al., 2019	No	38 m instead of 42 m	No
Kalmthoutse Heide	Laga & Notebaert, 1981d	No	No	No
Essen - Centrum	Laga, 1979	No	No	No
Nispen	Vernes et al., 2023	No	No	No
Roosendaal	Vernes et al., 2023	No	81 m instead of 78 m	No
Woensdrecht	Vernes et al., 2023	No	55 m instead of 44 m	No
Huijbergen	Vernes et al., 2023	No	59.5 m instead of 55 m	No
Zundert-Achtmaal	Vernes et al., 2023	No	No	No
Zundert-Wernhout	Vernes et al., 2023	No	No	No

Table 3. Overview of the thicknesses of the Merksem Member, Merksplas Formation and their sum in the different boreholes of this study. Boreholes with a thick Merksem Member are marked by green shading, and those without or with a very thin Merksem Member in orange shading. Notice that a thin Merksem Member corresponds to a thicker Merksplas Formation and vice versa.

Informal name by this study	Thicknesses in this study (see Figures 5 and 6)		
	Merksem Member	Merksplas Formation	Merksem Mbr + Merksplas Fm
Essen-Hoek	0	25	25
Essen-Wildert	15	13	28
Kalmthout -Nieuwmoer	2	20	22
Kalmthout - Putsesteenweg	15	12	27
Kalmthoutse Heide	0	25	25
Essen - Centrum	6	18	24
Nispen	0	25	25
Huijbergen	5	18	23
Zundert – Achtmaal	5	15	20
Zundert -Wernhout	16.5	12	28.5
Woensdrecht	6	20	26
Roosendaal	6	25	30
Average	6	19	25

References

- Deckers, J., De Koninck, R., Bos, S., Broothaers, M., Dirix, K., Hamsch, L., Lagrou, D., Lanckacker, T., Matthijs, J., Rombaut, B., Van Baelen, K. & Van Haren, T., 2019. Geologisch (G3Dv3) en hydrogeologisch (H3D) 3D-lagenmodel van Vlaanderen. Studie uitgevoerd in opdracht van het Vlaams Planbureau voor Omgeving, departement Omgeving en de Vlaamse Milieumaatschappij. VITO, Mol, VITO-rapport 2018/RMA/R/1569, 286 p. <https://dov.vlaanderen.be/page/geologisch-3d-model-g3dv3>, access 01/12/2023.
- Everaert, S., Deckers, J., Munsterman, D. & Wesselingh, F., 2023. The Pliocene–Pleistocene transition in the subsurface of the Dutch–Belgian border region: insights from borehole Huijbergen. *Geologica Belgica*, 26/1-2, 25–40. <https://doi.org/10.20341/gb.2023.001>
- Laga, P., 1979. Borehole description Essen 001E0044 at Watertoren van Pidpa. Archives of the Geological Survey of Belgium. <https://collections.naturalsciences.be/ssh-geology-archives/arch/001e/001e0044.txt>, accessed 28/12/2022.
- Laga, P. & Notebaert, K., 1981a. Borehole description Kalmthoutse Hoek 006W0028. Archives of the Geological Survey of Belgium. <https://collections.naturalsciences.be/ssh-geology-archives/arch/006w/006w0028.txt>, accessed 28/12/2022.
- Laga, P. & Notebaert, K., 1981b. Borehole description Essen Wildert 006E0134. Archives of the Geological Survey of Belgium. <https://collections.naturalsciences.be/ssh-geology-archives/arch/006e/006e0134.txt>, accessed 28/12/2022.
- Laga, P. & Notebaert, K., 1981c. Borehole description Nieuwmoer – Kalmthout 006E0133. Archives of the Geological Survey of Belgium. <https://collections.naturalsciences.be/ssh-geology-archives/arch/006e/006e0133.txt>, accessed 28/12/2022.
- Laga, P. & Notebaert, K., 1981d. Borehole description Kalmthout at Kalmthoutse Heide 006E0135. Archives of the Geological Survey of Belgium. <https://collections.naturalsciences.be/ssh-geology-archives/arch/006e/006e0135.txt>, accessed 28/12/2022.
- Vernes, R.W., Deckers, J., Walstra, J., Kruisselbrink, A.F., Menkovic, A., Bogemans, F., De Ceukelaire, Dirix, K., Duser, M., Hummelman, H.J., Maes, R., Meyvis, B., Munsterman, D.K., Reindersma, R., Rombaut, B., Van Baelen, K., van de Ven, T.J.M., Van Haren, T. & Welkenhuysen, K., 2023. Geologisch en hydrogeologisch 3D model van het Cenozoïcum van de Belgisch-Nederlandse grensstreek van De Noorderkempen/West-Brabant (H3O-De Voorkempen). TNO, Geologische Dienst Nederland, Utrecht, VITO; Vlaams Instituut voor Technologisch Onderzoek, Mol; Belgische Geologische Dienst van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel; TNO-rapport 2023 R10347 – VITO-rapport 2023/RMA/R/2906 – BGD-rapport 2023/02, 149 p. https://www.dov.vlaanderen.be/sites/default/files/pfiles_files/R10347%20H3O_De_Voorkempen_eindrapport_v5_ondertekend.mb3_.pdf, accessed 28/12/2022.